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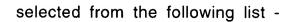
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CLAIMS

- Single stage laser amplifying apparatus comprising:
 an oscillator assembly for providing input light to be amplified;
 a pump laser for providing pumping; and
- an amplifier for amplifying the input light from on the order of 10^{-9} Joules to on the order of 10^{-3} Joules, the amplifier pumped by the pump laser;
- wherein the amplifier includes a cryogenically-cooled amplifying medium; and wherein the amplifier provides substantially all of the amplification of the amplifying apparatus.
- 2. The apparatus of claim 1, wherein the average power provided by the apparatus is between 1 Watt and 100 Watts.
- 3. The apparatus of claim 1, wherein the beam quality $M^2 < 2$.
- 4. The apparatus of claim 1, wherein the amplifying medium is a non-linear parametric amplification medium.
- 5. The apparatus of claim 4, in a single pass, high gain configuration.
- 6. The apparatus of claim 1, in a regenerative amplifier configuration.
- 7. The apparatus of claim 1, in a multipass amplifier configuration.
- 8. The apparatus of claim 1, wherein the amplifying medium has a host

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- a) Sapphire (Al₂O₃),
- b) Yttrium-Aluminum Garnett (Y₂Al₅O₁₂),
- c) Yttrium-Lithium Flouride (LiYF₄),
 - d) LiSAF (LiSrAIF₄),
 - e) LiCAF (LiCaAlF₄),
 - f) $KY(WO_4)_2$)
 - g) YVO₄, or
 - h) YAIO₃;

and wherein the the amplifying dopant has a host selected from the following list -

- a) Titanium (Ti³⁺),
- b) Neodymium (Nd³⁺),
- c) Chromium (Cr³⁺),
- d) Holmium (Ho³⁺),
- e) Erbium (Er³⁺),
- f) Thulium (Tm³⁺),
- g) Praseodymium (Pr³⁺),
- h) Ytterbium (Yb³⁺),
- i) Europium (Eu³⁺),
- j) Dysprosium (Dy $^{3+}$), or
- k) Terbium (Tb³⁺).

- 9. The apparatus of claim 1, wherein the amplifying medium comprises titanium doped sapphire.
- 10. The apparatus of claim 1, further including fiber optics for transmitting light between the pump laser and the amplifier.
- 11. The apparatus of claim 1, wherein the pump laser is selected from the following list:
 - a) diode-pumped frequency doubled Nd:YAG,
 - b) lamp-pumped frequency doubled Nd:YAG
 - c) semiconductor diode laser,
 - d) ruby laser,
 - e) diode-pumped Nd:Vanadate, or
 - f) diode-pumped Nd:YLf.

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12. Single stage laser amplifying apparatus comprising:

an oscillator assembly for providing input pulses to be amplified;

a pump laser for providing pumping; and

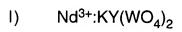
an amplifier for amplifying the input pulses [high gain], the amplifier pumped by the pump laser;

wherein the amplifier includes a cryogenically cooled amplifying medium;

wherein the amplifier provides substantially all of the amplification of the amplifying apparatus; and

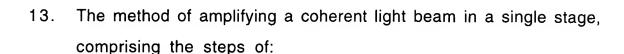
wherein the amplifying medium is selected from the following list:

- a) $Nd^{3+}:Y_3Al_5O_{12}$
- b) $Nd^{3+}:YAlO_3$
- c) $Ti^{3+}:Al_2O_3$
- d) Ce³⁺:LiCaAlF₄
- e) Ce³⁺:LiSrAlF₄
- f) $Nd^{3+}:LiYF_4$
- g) $Yb^{3+}:Y_3AI_5O_{12}$
- h) $Cr^{3+}:Al_2O_3$
- i) Cr³⁺:LiCaAlF₄
- j) Cr³⁺:LiSrAlF₄
- 20 k) Pr³⁺:LiYF₄



- m) Ho³⁺:YAlO₃
- n) $\text{Ho}^{3+}: Y_3 \text{Al}_5 \text{O}_{12}$
- o) Ho³⁺:LiYF₄
- 25 p) Er³⁺:LiYF₄
 - q) $Er^{3+}:Y_3Al_5O_{12}$
 - r) Er³⁺:YAlO₃
 - s) Tm³⁺:YAlO₃
 - t) $Tm^{3+}:Y_3AI_5O_{12}$





providing coherent input light to be amplified;

pumping the coherent light with a pump laser; and

amplifying the pumped coherent light from on the order of 10-9 Joules to on the order of 10⁻³ Joules with an amplifier;

wherein the amplifier includes a cryogenically-cooled amplifying medium; and

wherein the amplifier provides substantially all of the amplification of the amplifying apparatus.

- 14. The apparatus of claim 13, wherein the average power provided by the apparatus is between 1 Watt and 100 Watts.
- 15. The apparatus of claim 13, wherein the beam quality $M^2 < 2$.
- 16. The apparatus of claim 13, wherein the amplifying medium is a nonlinear parametric amplification medium.
- 17. The apparatus of claim 16, in a single pass, high gain configuration.
- 18. The apparatus of claim 13, in a regenerative amplifier configuration.
- The apparatus of claim 13, in a multipass amplifier configuration. 19.
- 20. The apparatus of claim 13, wherein the amplifying medium has a host selected from the following list -

- a) Sapphire (Al₂O₃),
- b) Yttrium-Aluminum Garnett (Y2Al5O12),
- c) Yttrium-Aluminum Flouride (LiYF₄), 5
 - d) LiSAF (LiSrAIF₄),
 - LiCAF (LiCaAIF₄), e)
 - f) YVO₄, or
 - YAIO3; g)

and wherein the the amplifying dopant has a host selected from the 10 following list -1005254 LICE

- titanium (Ti³⁺), a)
- neodymium (Nd³⁺), b)
- chromium (Cr3+), c)
- holmium (Ho³⁺), d)
- erbium (Er³⁺), e)
- thulium (Tm³⁺), f)
- praseodymium (Pr³⁺), g)
- ytterbium (Yb3+), h)
- europium (Eu³⁺), i) 20
 - dysprosium (Dy $^{3+}$), or j)
 - terbium (Tb³⁺). k)